

FURTHER NOTES ON SOME RARE AUSTRALIAN
CORDULINÆ, WITH DESCRIPTIONS OF NEW
 SPECIES.

BY R. J. TILLYARD, M.A., F.E.S.

(Plate x.)

The following species are dealt with in this paper :—

1. *Hemicordulia intermedia* Selys.
2. ,, *continentalis* Martin.
3. ,, *superba*, n.sp.
4. *Procordulia jacksoniensis* Rambur.
5. *Hesperocordulia berthoudi*, nov.gen. et sp.
6. *Lathrocordulia metallica*, nov.gen. et sp.
7. *Macromia viridescens*, n.sp.

The remarkable character and extent of the Australian *Cordulina* is becoming more and more emphasised. Including the four new species described in this paper, and a new species of *Cordulephya*, which I propose to deal with in a separate paper on that genus (to be published shortly), the total number of Australian *Cordulina* so far known is 34, out of a total of about 150 species described for the whole world; that is, two-ninths of the whole! Out of a total of 36 genera, no less than 14 are represented in Australia; and of these, twelve are peculiarly Australian or Australasian.

1. HEMICORDULIA INTERMEDIA Selys.

Besides the type-male in Hagen's Collection, only two other specimens of this rare insect were known. These were two males

of rather small size, taken by me at Cooktown in January, 1908.* It was with great surprise and pleasure, therefore, that I rediscovered this species on the Horton River, at Pallal, near Bingara, N.S.W. Though it was by no means common, I secured a very fair series of seventeen males and four females, mostly in excellent condition. These are of larger size than the Cooktown specimens, and agree very closely with Hagen's type, which probably came from Southern or Central Queensland. As I have already figured and discussed the male in my former paper, it is only necessary here to give the measurements of the Pallal series, and to describe the hitherto unknown female.

♂. Total length, 44-46; abdomen, 32-34; hindwing, 29-31 mm.

Differs from the figure of the Cooktown male† in possessing a broader, more *corduliform* abdomen; otherwise the form and markings correspond exactly.

♀. Total length, 48; abdomen, 35; hindwing, 31 mm.

Wings: *neurulation* blackish, except costa, subcosta and antenodals, pale brownish. A tinge of saffroning at bases, especially near membranule of hindwing. *Pterostigma* 2 mm., very dark brown. Head and thorax as in male, but with somewhat duller colouration, the yellow on the front being replaced by glaucous-grey, and the T-mark being less distinct; also the black thoracic bands not quite so wide. Abdomen: 1, 2, and half of 3 much swollen, the rest nearly cylindrical but tapering slightly to 10. Colouring as in male, but with the black markings of 2 and 3 much larger and broader; 9, quite black; 10, very short, basal half black, apical half clear yellow. *Fulvar lamina*: end of 8 with two small yellow rounded projections; 9 rather hollow, with the central ridge projecting apically, pale brownish. Appendages: 1-6 mm., black, hairy, narrow sublanceolate, wide apart, separated by a hairy rounded tubercle on 10, which carries a double yellow spot above.

* See these Proceedings, 1908, xxxiii., p.740, Pl.xxi., figs 2-4.

† *Loc. cit.* Pl.xxi., fig.2.

Hab.—Pallal, N.S.W.; in December, 1910. It is confined to the main Horton River, and only occasionally appears on the smaller creeks.

Types: ♂, in Coll. Hagen (Queensland); ♀, in my collection.

2. HEMICORDULIA CONTINENTALIS Martin.

Four males and three females of this rare species were taken by Mr. H. Elgner at Darnley Island, Torres Strait, in December, 1909. Mr. F. P. Dodd has also taken a single male, immature, at Port Darwin (undated). These are now in my collection. They all resemble very closely the small-sized male taken by myself at Kuranda, N. Queensland, in January, 1905.† M. René Martin's types, taken in New South Wales and Queensland, are larger. This species, like the preceding, clearly attains its greatest development in Central-East Australia, the tropical representatives being somewhat dwarfed.

3. HEMICORDULIA SUPERBA, n.sp. (Plate x., figs.5-8).

♂. Total length, 54; abdomen, 40·5; hindwing, 33 mm.

Wings: *costa* pale yellowish outwards to nodus, rest of neuration black; *pterostigma* 1·6 mm., black; *membranule* narrow, forewing 1·5, hindwing 2·3 mm., grey-brown touched with white at bases; subtriangle of forewing generally 3-celled, but sometimes 2-celled on one or both sides. *Nodal Indicator* || 7-8, 5

Head: *eyes* dark greenish (brown in dead insect); || 5, 6-7
vertex tubercled, small, yellow above, dark steel-colour on sides; *antennæ* black, 2·5 mm., *front* somewhat indented medially, black with steely or greenish metallic reflections, two very conspicuous round yellow spots above, wide apart: lower part of *front*, *clypeus*, *labrum* and *labium* bright yellow, two small dull black dots in upper labral suture, and a distinct bright black dot in middle of base of labrum. *Thorax*: *prothorax* small, metallic steely black, with a dorsal yellow spot and broad yellow basal collar. *Meso-* and *metathorax* black, with metallic steely or greenish reflections above, a short yellow line on dorsal ridge, and two rather irregular yellow antehumeral bands, pointed forwards and broadening

† *Loc. cit.* p.742.

inwards basally near interalar ridge; this inner extension being slightly clouded with grey. Sides bright lemon-yellow, with two very irregular metallic black bands in sutures. *Notum* downy, wing-bases broadly black with a conspicuous yellow spot on hind wing-bases, scuta and scutella yellow. *Legs* long, black, except coxæ, which are yellow, also foretrochanters, part of underside of profemora, and part of midtrochanters yellow; *tibial keel* of fore-legs 2.5 mm. long. *Abdomen*: 1-2 enlarged, 3 pinched, 4-7 rather broad, 8-10 narrower. *Colour*: 1, bright lemon-yellow; 2, steely black, with a central transverse yellow band just broken dorsally; 3-10 black, with steely and greenish metallic reflections, marked with bright lemon-yellow as follows—3, on each side a long stripe crossed at the middle by a black line on the supplementary carina; 4, two large basal marks reaching to supplementary carina, 2 mm. long, and isolating a narrow irregular dorsal band; 5, two smaller basal spots nearly meeting dorsally, also two tiny central flecks; 6 similar to 5, basal spots somewhat narrower, central flecks reduced to points (sometimes absent); 7, basal half yellow, with a fine black dorsal line, the *junction of the black and yellow very irregular*; 8, a small basal spot low down on each side; 9, black; 10, basal suture yellowish, a conspicuous apical yellow spot. *Appendages*: *superior* long, 3.7 mm., with many small hairs, black, very wavy; basal fourth slender, with a sharp and conspicuous inner inferior spine; second quarter widening and curving outwards; third quarter still wide, curving inwards; apical quarter tapering to tips, which are fairly pointed. Seen in profile, the second half is much depressed below level of first half. *Inferior* short, scarcely 2 mm., black, narrow-triangular, hairy beneath, concave above. (Plate x., figs.5-6).

♀. Total length, 51; abdomen, 39; hindwing, 34 mm. Similar to male, but with shorter and more cylindrical abdomen; 1-2 somewhat enlarged (in profile, 1, 2 and half of 3 much swollen), 3-6 quite cylindrical, 7-10 tapering slightly. *Colour*: 1, yellow; 2, yellow, with a rectilinear basal black patch and large triangular apical black patch spreading irregularly down over the sides; 3, as in ♂, but with dorsal black area much wider; 4-10 as in ♂. *Vulvar lamina*: 8 ending in two small rounded processes, bright

yellow edged with black; base of 9 with two small double tubercles, semi-transparent, very pale, rest of 9 with a rather blunt central black ridge projecting apically (Plate x., figs.7-8) Appendages 2 mm., black, downy, narrow-lanceolate, with a rounded hairy tubercular projection of 10 lying below and between them.

In the female, the wings are often tinged with yellowish-brown on the apical half, between nodus and pterostigma; this disappears in very mature females.

Hab.—Pallal, N.S.W.; in December, 1910. Nine males and six females in good condition, taken by myself.

Types: ♂♀ in my collection

Along the coast of Australia, from South to West Australia, through to Adelaide and Melbourne, and up to north of Sydney, the two representatives of the genus *Hemicordulia* are *H. tau* and *H. australis*. The former is found everywhere, even on the smallest waterhole, but the latter is confined to the rivers. My visit to Pallal enabled me to obtain some idea of the distribution of species west of the main ranges. I find that *H. tau* is by no means common, and usually occurs on stagnant ponds and waterholes, station-dams, etc., where it has evidently followed settlement into the interior. On the main rivers it is very rare, but occurs occasionally. I am inclined, therefore, to regard *H. superba* and *H. intermedia* as the western representatives of the genus. Of these two, there is no doubt that the latter fills exactly the place occupied by *H. australis* along the coast. In flight and habits these two species are very similar, though in colouration *H. intermedia* inclines rather to *H. tau* than to *H. australis*. *H. superba* has, as far as I know, no coastal representative. In colouration it is almost exactly like *Synthemis regina*, the largest and most beautiful of the *Synthemina*. These two species were flying together high up in the clearings along Tea-Tree Creek, near Pallal. It was quite impossible to tell at sight which species was which, for *H. superba* imitates the flight of *S. regina*, soaring slowly and calmly to and fro. If struck at, however, the difference in flight-power is at once evident—*H. superba* immediately making off at immense speed, while *S. regina* is usually

only slightly disturbed, and returns again to its old haunt, being thus easily captured. On the Horton River at Pallal, a broad flowing stream, *S. regina* does not occur, but the males of *H. superba* patrolled the banks, generally keeping just out of reach of the net. Here they flew swiftly, stopping frequently at some fancied spot, and remaining poised and stationary, with eyes gleaming and all their brilliant colouring well displayed. The only way to catch them was to note where they turned into some small bay or inlet to capture gnats, and then to hide behind some bush ready to strike at the insect on his next visit. Failure at the first stroke sent the insect far away, probably to take up some other "beat" on the river.

These insects appear to be rather fiercely disposed towards the dragonflies on the river. Generally three or four *H. intermedia* would "patrol" past before an *H. superba* came in sight, and the former kept closer in shore and were easier to capture. The larger insect, however, would often dart in and attack the smaller, driving it away just as I was about to strike. This was done with such rapidity that it was almost impossible to follow what took place.

This fine insect is easily the most distinct and beautiful member of the genus. It is probably most closely related to *H. intermedia*, but can be at once distinguished from that species by its much greater size, more brilliant colouration, by the peculiar pattern of the front (which may be considered as the intermediate stage between the T-mark and the bright metallic crest), also by the very long appendages of the male. The actual colour-pattern of the abdomen is very similar to that of *H. intermedia*, but whereas in the latter the join of the black and yellow on segment 7 is *quite straight*, in *H. superba* it is *very irregular*. The very distinct antehumeral yellow bands of the thorax distinguish it at once from all other members of the genus, and the beautiful colour-pattern of the sides of the thorax is also unique.

Omitting *H. nova-hollandiae* Selys, for the present, from the following table, since nothing certain can be gathered about this species (unless, indeed, as seems very probable, *H. continentalis*

Martin, is synonymous with it), we can now classify the Australian members of the genus *Hemicordulia* as follows:—

- | | | | |
|----|---|--|-------------------------|
| 1. | { | Front with a distinct black T-mark above..... | 1. |
| | | Front without a distinct black T-mark above..... | 2. |
| 1. | { | Segment 7 with basal half yellow, cut straight off across middle of segment. (Appendages of ♂ with a sharp spine)..... | <i>H. intermedia.</i> |
| | | Segment 7 metallic greenish-black, with orange low down on sides. (Appendages of ♂ with upturned tips, no spine) | <i>H. tau.</i> |
| 2. | { | Front with two distinct round yellow spots above..... | <i>H. superba.</i> |
| | | Front brilliant metallic greenish above..... | 3. |
| 3. | { | Appendages of male with a sharp spine | <i>H. australiæ.</i> |
| | | Appendages of male without any spine..... | <i>H. continentalis</i> |

Note.—It is difficult to separate the females of *H. australiæ* and *H. continentalis*, but the latter is generally smaller, has a shorter pterostigma, and slightly longer appendages than the former.

4. PROCORDULIA JACKSONIENSIS Rambur.

This insect was, until lately, exceedingly rare in collections. In the de Selys Collection there are Rambur's four types, from New South Wales; and a specimen in Hagen's Collection is said to come from Western Australia, though this is very doubtful. I took a single female at Gisborne, Vic., in December, 1908; and was agreeably surprised to find it, in swarms, on the lagoons near Cressy, Tasmania, in January, 1909. There I took about eighty magnificent specimens, and also found the larva. The following is a description of the Cressy series:—

♂. Total length, 44-45; abdomen, 32-33; hindwing, 28-29 mm.

Wings: bases just touched with black and saffron; *pterostigma* brown, 2 mm.; *membranule* 4.5 mm., dark brown tipped with white. *Nodal Indicator* || 7-8 6 || Head: eyes dark brown, with soft grey hairs || 5 6-7 || behind; *vertex* small, brown; *front* wide, somewhat depressed medially, brilliant metallic green above, yellow on sides, glaucous-brownish shading to livid-grey on face; *clypeus* and *labrum* glaucous-greyish; *labium* pale dirty straw-colour. THORAX: *prothorax* pale brown above, dark brown on sides. *Meso-* and *metathorax* very hairy, burnished

bronze-green, touched with brown on shoulders; *underside* brown, *notum* brown, wing-bases hairy, scuta and scutella pale straw-colour. *Legs* black, profemora and underside of metafemora brown. *Abdomen*: 1-2 enlarged, 3 somewhat pinched; rest of abdomen considerably dilated, 4-7 very wide, 8-10 tapering rapidly. *Colour*: 1-2 dark brown, each with a conspicuous transverse apical band of cream-colour; 3-10 dark metallic greenish-black above, sides rich orange except near sutures, the orange patches being only *slightly* widest near middle of each segment; 3-9 with a narrow, transverse, apical band of cream-colour; 10, apical half orange, with a small spine on each side. *Appendages*: *superior* 2 mm., narrow curved sublanceolate, approaching each other so as nearly to touch at two-thirds of their length, the apical one-thirds strongly divergent and somewhat depressed, tips rounded; colour black, with a few small hairs. *Inferior* 1.5 mm., subtriangular, tip slightly upcurved; pale brown bordered with black.

♀. Differs from male as follows: metallic colour of front much duller, sometimes brownish, thorax less metallic. *Abdomen* broad, almost cylindrical, the orange and metallic colouration duller; 10 with basal third black, the rest orange. *Vulvar lamina* with two short subtriangular projections from end of segment 8. *Appendages* 2.3 mm., rather thick, hairy, dark brown, outer edge straight, inner edge distinctly curved, tips slightly pointed.

Hab.—Tasmania: abundant on the lagoon near Cressy, also fairly common on the Macquarie River (January, 1909). Victoria: Gisborne, 1 ♀ (December, 1908).

Types: ♂♀ Coll. Selys (four specimens from N. S. Wales). The fine series from Cressy has been distributed by me, as far as possible, amongst all the modern collections; my own series contains 22 males and 13 females.

An interesting fact concerning this insect is that it is undoubtedly being rapidly exterminated from the Tasmanian rivers by the introduced English trout. I am quite certain that it scarcely ever breeds in the rivers now, and that the specimens that fly on the Macquarie River are the overflow of the abundant swarm from the lagoons. On the fine North and South Esk

Rivers not a specimen can be seen; indeed the Odonate fauna of these streams, and of the beautiful Derwent River in the south, is almost completely annihilated. The following analysis of the contents of the stomach of a fine trout (about 3 lbs.) taken by me in the Macquarie River may be of interest—a portion of a single beetle, and *thirty-seven* undigested dragonfly heads, of which *no less than thirty-two* were recognisable as those of *Procordulia jacksoniensis*, the other five being apparently *Austrogomphus guérini*. While trout-fishing, I carefully observed this species, and noticed that it is very fond of skimming the surface of the water, like a *Libelluline*. This is a fatal habit, for I saw, several times, a trout seize the insect while in rapid flight close to the water. I also noticed that it often *dips itself* in the water, and then rises and hovers for a short while. On one such occasion, a kingfisher dashed down and seized the insect.

One might venture the prediction that, in a very few years' time, this insect will be confined to the lagoons, and that it will become a dull-coloured uninteresting-looking species of more robust build than at present, the supply of food on the lagoons being more abundant. Compared with its congener, *P. affinis* Selys, of Western Australia, which is only found on the running brooks, it is already of a thick-set and more robust habit, and of a much duller colour on the abdomen.

I am of opinion that the two species, *P. jacksoniensis* and *P. affinis*, are truly geminate species, portions of an original single stock which became separated by the great Desert Barrier. *P. affinis* has followed the line of development of *Hemicordulia australiæ*, which species it exactly resembles in flight and colouration; while *P. jacksoniensis*, though still retaining the metallic front, is following the line of development of *H. tau*.

The three genera, *Somatochlora*, *Procordulia*, and *Hemicordulia*, are of great interest to students of zoogeographical distribution. *Somatochlora* is evidently the most archaic, and is one of the few genera of known bipolar distribution. In the subarctic regions of Canada and Siberia, it has attained its greatest development. But alongside that development, we find it represented in the subantarctic regions of New Zealand and Chili, by a small

remnant at the present day, consisting of only three species (*S. grayi* Selys, *S. braueri* Selys, and *S. villosa* Rambur; the first two from New Zealand, the last from Chili). The main body of the southern *Somatochlora*-stock may have included a large number of species at a period when our southern land-areas were much larger than they are now. Before and during Miocene times, these were becoming faced with a harder struggle for existence, mainly due to the shrinkage of their territory; so that a remnant gradually fought their way northwards to the warmer temperate and even to tropical regions. As this proceeded, they became modified, firstly to the intermediate *Procordulia*-type, and finally to the *Hemicordulia*-type, which, in its rounded hindwing in both sexes, shows a cænogenetic convergence to the *Libellulinae*.

The most archaic forms are evidently those northern species of *Somatochlora* whose females still retain a remarkably enlarged terebra. Our three southern species show a definite advance in the reduction of the vulvar lamina to the more usual *Libellulid* proportions. The gradual rounding of the anal angle of the hindwing of the male is clearly seen in comparing the three genera, *Procordulia* showing a "half-way" stage, between *Somatochlora* and *Hemicordulia*. Also the second cubital cross-vein of *Somatochlora* is eliminated in the two latter genera.

HESPEROCORDULIA, nov.gen. (Plate x., fig.1).

Head and thorax robust. Legs long and slender. Abdomen slender, cylindrical. Triangles of all wings and subtriangle of forewings free. Sectors of arculus separated at bases. Arculus placed between first and second antenodals, but nearer to former than to latter. Triangle of hindwing almost completely recessed to level of arculus. Only one cubital cross-vein in hindwing, and hence no hindwing-"subtriangle." Post-trigonal space of forewing beginning with one row of cells, but sooner or later giving place to two (variable). Anal loop long and narrow, fairly well defined, apical end not enlarged, but cut straight off by a transverse vein; longitudinal bisector fairly well defined. A small cross-vein low down in anal triangle of hindwing.

Type: *Hesperocordulia berthoudi*, n.sp.



This genus is intermediate between the two main divisions of the *Cordulina* (s.str.), of which the typical genera may be taken to be *Somatochlora* and *Syncordulia*. To the former, it is related by its robust build (large head and thorax), long slender legs, and open venation; also by the practically complete recession of the hindwing-triangle to the arculus, and by the long anal loop, showing a longitudinal bisector. With the latter, it agrees in its slender noncorduliform abdomen, and in its uncrossed triangles and forewing-"subtriangle." Of Old World genera, it probably comes closest to *Oxygastra*, which it resembles closely in the form of its anal loop, triangles and forewing-"subtriangle"; it differs, however, from this genus in not possessing the second cubital cross-vein in the hindwing, and in the *almost complete* recession of the hindwing-triangle.

In colouration, it is quite unlike any known *Corduline*, being bright red and black. This colour and the regular pattern of the abdomen, together with the thoracic colour-scheme and the shape of the head, thorax, legs and abdomen, irresistibly suggest a far closer relationship between this genus and *Cordulephya* than a comparison of the wing-venations would indicate.

5. HESPEROCORDULIA BERTHOUDI, n.sp. (Plate x., figs. 1, 3, and 9).

♂. Total length, 54; abdomen, 41; hindwing, 30.5 mm.

Wings: a small patch of orange at nodus, also at base of wings (this colouring disappearing when the insect becomes fully matured). *Pterostigma* 2 mm., orange. *Membranule* narrow, whitish, fore 2, hind 4 mm. *Nodal Indicator* | 7 5 |
 Head: *eyes* dark reddish-brown; *vertex* blackish; | 5 7 |
front deeply cleft medially, yellowish-brown, shiny; *clypeus* shiny-brownish; *labrum* reddish-brown; *labium* orange. **Thorax:** *prothorax* small, brownish. *Meso-* and *metathorax* rich orange-brown, with very long grey hairs; marked with bright metallic greenish as follows—basal portion of dorsum on each side of dorsal ridge carrying a large irregular patch, subrectangular, with its upper part cut out rectangularly; on each side a large spot near mesocoxa, also a broad sublateral band; *notum* orange-brown; *legs* long, black. **Abdomen** slender, 1-2 somewhat

enlarged. 3 narrower, 4-6 narrow, 7-10 slightly enlarged. *Colour*: 1, metallic black; 2, rich orange-red, with very small auricles, a broad transverse apical band of black; 3-7 bright orange-red, marked with metallic black as follows—3, an apical transverse black band projecting in a black line along dorsum to middle of segment; 4-7, apical half black; 8, black, with two large basal orange-red spots reaching nearly to middle of segment; 9-10, brownish on dorsum, sides irregularly marked with black. *Appendages*: *superior* very long, slender, 4·8 mm., slightly wavy, diverging a little at base, then slightly converging; tips roundish; inner margin very hairy, showing, when viewed sideways, a very small obtuse projecting spine one-third from base; colour blackish. *Inferior* 2 mm., elongate subspatulate, tip rather truncated, slightly upcurved; colour semitransparent orange, with darker tip (Plate x., figs 3, 9).

♀. Total length, 48; abdomen, 36; hindwing, 31·5 mm. It differs from the male as follows. *Wings*: *pterostigma* 2·5 mm., orange; *costa* of all four wings washed with orange, especially at base, nodus, and pterostigma (this colouring most intense in the young female, persisting in the mature female, and only disappearing in very matured specimens). *Head*: *front*, *clypeus*, and *labrum* orange. *Thorax* as in ♂. *Abdomen*: broader and shorter than in ♂; colour orange-red, slightly duller than in ♂; 1, blackish; 2-7 with apical black bands, narrow on 2, then broadening gradually until they are nearly half as broad as the whole segment on 6 and 7; 5-7 with the black running up along the dorsum in a sharp spike; 8, as in ♂, but duller; 9, orange, with two small apical black spots; 10, very short, orange. *Vulvar lamina* very short, slightly bifid, rounded, black; two small point-tubercles on 9. *Appendages* 1·3 mm., wide apart, narrow, straight, pointed, brownish, separated by a large bifid tubercle on 10.

Hab.—Waroona, W.A.; November-December, 1909 and 1910. Taken by my friend, Mr. G. F. Berthoud, to whom I dedicate this species.

Concerning this very remarkable dragonfly, Mr. Berthoud writes to me as follows. "The captures range from October (end) until towards end of December. I never saw a single one

in the new year. I do not know if they die out or go elsewhere, but they cannot be found about here in January. They frequent thick 'blackboy' and palm-scrub close to the brook, but I never saw them hawking about on the water. They sit on the leaf of a 'blackboy' or palm, flying off at the least alarm, usually upwards over the scrub, and alight again a chain or two away on another leaf. If one can see or note the spot, they may be captured fairly easily. On the wing, they are very active and mostly high out of reach. I once saw a pair *in cop.*, but failed to get them. Although fairly numerous, they are not easily caught, and it takes a lot of careful hunting to get a few. On some very good days I have taken four, but mostly only one or two. The fine, highly-coloured males are especially smart, keeping well out of my reach."

Types: ♂♀, and series of cotypes, in my collection.

LATHROCORDULIA, nov. gen. (Plate x., fig.2).

Head and thorax robust. Legs *short*. Abdomen slender, cylindrical. Triangles of all wings and subtriangle of forewings free. Sectors of arcus separated at bases. Arculus placed about midway between first and second antenodals. Triangle of hindwing *nearly* recessed to level of arculus. Second cubital cross-vein of hindwing present, forming a small "subtriangle." Post-trigonal space of forewings with one row of cells up to near tip of wing. Anal loop rather short, only moderately well defined, with no straight apical boundary, and no defined longitudinal bisector. A small cross-vein low down in anal triangle of hindwings.

Type: *Lathrocordulia metallica*, n.sp.

Allied to *Syncordulia*,* from which it can be at once separated by its more robust build (especially its large head and thorax), its more open venation and smaller number of ante- and post-nodals, the greater amount of recession of its hindwing-triangle, and its more poorly developed anal loop. Also closely allied to

* It must be understood that I refer here to *S. atrifrons* McLach., which I assume is congeneric with the type *S. gracilis* Burm., of which no really reliable or sufficiently full descriptions are available.

Gomphomacromia (*G. paradoxa* Brauer), which it resembles in the shape of its triangles, and the presence of the second cubital cross-vein in hindwing. The form of the anal loop is intermediate between those of *Syncordulia* and *Gomphomacromia*.

6. LATHROCORDULIA METALLICA, n.sp. (Plate x., figs.2, 4, and 10).

♂. Total length, 54; abdomen, 42; hindwing, 31 mm.

Wings: *neuriation* black, open; with about 1 mm. of dark saffroning at wing-bases. *Pterostigma* 3 mm., orange between black nervures. *Membranule* large, greyish-white, forewing 2, hindwing 4 mm. *Nodal Indicator* $\parallel \begin{array}{c} 6 \quad 5-6 \\ 4 \quad 6-7 \end{array} \parallel$ first two or three postnodals of all wings not complete. Head dark brown, hairy, a tinge of purplish on vertex and frontal ridge; *front* widely, almost semicircularly, cleft in the middle; *labrum* and *labium* more inclined to fulvous. Thorax dark brown, with grey downy hairs. On each side of dorsal ridge is a band of metallic green; sides also reflecting metallic green or rich steel-colour nearly all over, underside brown. Legs rather short, black. Abdomen slender, subcylindrical, 1-2 enlarged, 3 narrow, the rest gradually enlarging to 9, which is nearly as wide as 2. Colour: 1-2 very dark brown, auricles of 2 small, semitransparent brown; rest of abdomen rich dark bronze-green (fading to dull blackish in the dead insect). Appendages: *superior* long, 4.6 mm., slightly wavy, diverging for 1 mm.; then converging so as to touch at tips; black; apical two-thirds hairy, especially on the inside. *Inferior* short, 2 mm., subtriangular, fairly pointed, tip *very slightly* bifid; semitransparent brownish, darker at tip, which is upcurved (Plate x., figs.4, 10).

♀. Very similar to ♂, but differs from it as follows:—Total length, 50; abdomen, 36.5 mm.; wings same length as in ♂, but with a greater amount of saffroning at bases (2 mm. in hindwing). Abdomen thicker and more cylindrical than in ♂; 1-2 slightly enlarged, 3-7 cylindrical, 8-10 slightly enlarged. *Vulvar lamina* of 8, with lateral folds disclosing a triangular area with its apex at the base of the segment, vulvar scale slightly bifid; 9 with lateral folds wide apart, disclosing a semitransparent brown ventral surface carrying two small projecting points; 10 flattish beneath,

very hairy at end. Appendages wide apart, 1·8 mm. long, straight, pointed, black.

Hab.—Warooka, W.A.; very rare. Three males and three females in good condition, taken by Mr. G. F. Berthoud, the captures ranging from the end of November to the third week in December, 1910. Of this dragonfly, Mr. Berthoud writes—“It is a beautiful active insect, found in the same locality as, and with similar habits to *H. berthoudi*; in life, the colour is a rich dark bronze-green with fine metallic sheen, but, in dying, their beauty fades a little.” The description given above of the habits of *H. berthoudi* applies also, he says, to this species.

Types: ♂♀, and cotypes, in my collection.

7. *MACROMIA VIRIDESCENS*, n.sp. (Plate x., fig. 11).

♀. Unique. A magnificent species: total length, 66; abdomen, 49; forewing, 51; hindwing, 48 mm.

Wings: *venation* black, strong; bases saffroned for about 10 mm. in forewings, 5-7 mm. in hindwings. *Pterostigma* very small, 1·5 mm., dull semitransparent brown, scarcely covering one cellule (Plate x., fig. 11). *Nodal Indicator* || 17-18 10-11 |
Membranule in forewing 2 mm., narrow, greyish; || 10-11 11-12 |
 in hindwing 4·5 mm., narrow, pointed, greyish shading to dull brown. *Anal loop* of hindwing containing 16 cells; considerably wider than deep. *Head*: *eyes* very large, brown; *vertex* highly tubercled, small, brilliant metallic green; *front* downy, deeply cleft medially, rich metallic violet above, shading to brownish near clypeus; *postclypeus* very wide, yellow; *anteclypeus* dark brown, a sharp triangular median portion of the brown mounting into the postclypeus; *labrum* shining black; *labium* very large, brown; *genæ* dark brown. *Thorax* deep brilliant metallic-green all over, except for a thin yellow dorsal line, a pair of short straight *humeral* yellow bands ending quite 2 mm. before the interalar ridge (which is itself broadly yellow), and, on each side, a fairly broad straight lateral yellow band enclosing the blackish mesospiracle; *nunderside* brownish; *notum* very dark brown, crossed by the continuous lateral bands. *Legs* black, *coxæ* brown; numerous long spines on tibiæ. *Abdomen*

cylindrical (rather flat in the type, which is not fully matured), shining metallic-blackish from 6 to 10; 5 showing green reflections; 1-4 brilliant metallic-green; 1, brownish on sides; 2, a pair of small basal dorsal yellow spots, a narrow transverse yellow band interrupted for 1 mm. on dorsum; 3, a fine yellow transverse line close up to the suture; supplementary carinæ on 3-6 black; 4-6 with no markings; 7 with basal half of dorsum yellow; 8-10 with a touch of yellow low down on each side. *Vulvar lamina* with two leaf-like folds or lobes about 1 mm. long, rounded. Appendages 1 mm., black, conical, downy, separated by the triangular end of 10, under which projects a longish irregular tubercle.

Hab.—Cape York, N. Queensland. A unique ♀, taken by Mr. H. Elgner, on November 22nd, 1909, and now in my collection.

It is now necessary to consider further the position of the new Australian genera (described by me in this, and the preceding paper) in the subfamily *Corduliinae*. These are *Austrophya*, *Austrocordulia*, *Pseudocordulia*, *Hesperocordulia*, and *Lathrocordulia*. This is a difficult task, mainly because of the unsatisfactory state of our knowledge of the *true affinities* of the members of the group *Cordulinae*,* to which all these genera belong. It must be borne in mind that, in a group of this kind, containing the more highly specialised and advanced members of the subfamily, convergence of forms is very likely to occur. This is particularly the case as regards wing-venation, in forms where the tendency has been towards reduction rather than amplification. In the struggle for existence, it is not always the imago that undergoes the most complete modification; in the *Odonata*, at any rate, there are groups in which the main line of specialisation has been confined to the larvæ, the imagines remaining of a fairly generalised type—and yet there is no reason to believe that such forms are foredoomed to failure. The *Gomphiinae* are a good illustration of this point. Now in the *Corduliinae*, one can distinguish various tendencies at work, resulting in the

* In my "Monograph of the genus *Synthemis*" I separated the *Corduliinae* into *Synthemina*, *Macromina* and *Cordulina*, leaving the latter group for further revision and subdivision if necessary.

formation of what may be termed *strong* and *weak* groups of imagines. For instance, the *Macromina* on the strong side, and the *Synthemina* on the weak side are two successful results of one line of development. Though, in wing-venation, the *Macromina* have progressed far beyond the *Synthemina*, yet the balance is probably maintained by the better larval development of the latter (as I have already shewn, these larvæ resist drought and starvation to a degree hitherto unprecedented in known forms). It has, therefore, occurred to me that, if we knew the larvæ of those forms which I have grouped together in the *Cordulina*, we might find the same "strong" and "weak" tendencies of the imagines (balanced by the opposite tendencies in the larvæ) clearly enough indicated to enable us to subdivide the group into two sections co-ordinate with the *Macromina* and *Synthemina*.

As I cannot claim a very intimate knowledge of some of the genera that are not Australian, and as the life-histories of so many species still remain quite unknown, I shall confine this discussion to the Australian genera, together with a few of the better known Old World forms when necessary. A cursory glance at the Australian members of the *Cordulina* suggests, at once, a "strong" and "weak" line of development. The *strong* group, typified chiefly by robust head and thorax, long legs, more or less corduliform abdomen, and elongated anal loop, together with complete recession of the hindwing-triangle to the areculus, is clearly represented by the great genus *Somatochlora* (bipolar) and its offshoots, *Procordulia* and *Hemicordulia*. The *weak* group, typified by smaller head and thorax, short legs, thin nearly cylindrical abdomen, and shortened anal loop, together with incomplete recession of the hindwing-triangle, is represented by *Syncordulia* and its allies, amongst which I number *Austrophya*, *Austrocordulia*, *Pseudocordulia*, and *Lathrocordulia*.

Were these two groups represented by a single type of larva, I should be content to leave the *Cordulina* as a single group coordinate with *Macromina* and *Synthemina*. But the discovery of the remarkable larva X* (the actual species is still undeter-

* "On some Experiments with Dragonfly Larvæ." These Proceedings, 1910, xxxv., p. 667.

mined), proves the existence of two larval types, somewhat parallel in their lines of development with those of *Macromina* and *Synthemina*. The larva X belongs to an unknown species, whose venation is *exceedingly close to that of Syncordulia* (until I have actually succeeded in breeding it out, I cannot say definitely whether the species will go into *Syncordulia* or not). In many respects (though certainly not in appearance), it resembles the larva of *Synthemis*. Thus, it is a short thick-set larva, with very short legs, is very inert and fond of concealing itself; it can withstand starvation and drought almost as well as the larva of *Synthemis*, and, in its labial development, it shows irregular and deep incisions. Contrast this with the well-known *Hemicordulia*-type of larva (Needham* has described the larvæ of *Epicordulia*, *Tetrayoneuria*, *Somatochlora*, *Helocordulia*, *Cordulia*, and *Dorocordulia*, all of this type).

There we have a spider-like larva, with large head, broadly oval body, and very long legs; one that relies for protection on its colour-pattern, and lives uncovered on the pond or river-bottom; apparently with no power to endure either starvation, or even a short drought; and with a labial development of the *Libelluline* type, characterised by exceedingly shallow crenations, often armed with sets of tiny spines, and with the lateral lobes often spotted with warts and dots. In general form and habits, these larvæ resemble the *Macromiun* larvæ, though the latter still retain the deeply indented labium characteristic of the original *Corduline* stock.

I propose, therefore, to subdivide the group *Cordulina* into two groups, which I am at present inclined to regard as coordinate in value with the *Macromina* and *Synthemina*. But, as these two groups include a larger number of forms, and those more widely distributed over the earth, we must be prepared to find intermediate genera connecting the two main lines of development. Such genera would probably be difficult to place in any linear classification. Also, further knowledge of life-histories may prove

* New York State Museum. Bulletin 47, September, 1901. "Aquatic Insects in the Adirondacks."

the existence of one or more coordinate groups besides these, necessitating further subdivision:—

GROUP i. Larva with large head and thorax, very long or fairly long legs, broadly oval abdomen; *labium* of *Libelluline* form, with no deep incisions of the outer edge of the lateral lobes, but with shallow crenations generally armed with sets of small spines; lateral lobes often with small warts or dots scattered over the surface; numerous mental and lateral setæ.

Imago with robust head and thorax, long legs, usually more or less corduliform abdomen. *Wing-venation* characterised by large triangles, and forewing-subtriangle, usually all crossed; complete or practically complete recession of hindwing-triangle to arculus; large triangle and forewing-subtriangle; anal loop considerably elongated, with a more or less definite longitudinal bisector.....*Eucordulina*.

GROUP ii. Larva with smaller head and thorax, short or very short legs, large oval abdomen, very flat beneath; *labium* with deep irregular incisions, armed with small spines, but without warts or spots; not many mental or lateral setæ.

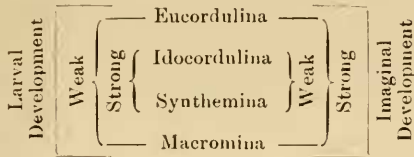
Imago with smaller head, small or moderate thorax, short or very short legs, and usually a slender cylindrical abdomen. *Wing-venation* characterised by incomplete recession of hindwing-triangle; triangles and subtriangle free, and smaller than in Group i.; anal loop short or fairly short; with no longitudinal bisector.....*Idocordulina*.

In the *Eucordulina*, I include the following genera—*Hemicordulia*, *Procordulia*, *Scmatochlora*, *Paacordulia*, *Dorocordulia*, *Cordulia*, *Helocordulia*, *Epicordulia*, *Tetragoneuria*, *Epitheca*, *Neurocordulia*, *Aeschnosoma*, *Libellulosoma*, *Pentathemis*, *Plutycordulia*; also *Orygastra* and *Hesperocordulia*, which are the connecting links with the *Idocordulina*, but appear to me to deserve inclusion rather in the *Eucordulina*; and finally, *Cordulephya*, for reasons that will be given in a separate paper on that genus.

In the *Idocordulina* I include—*Syncordulia*, *Lathrocordulia*, *Neocordulia*, *Austrocordulia*, *Nesocordulia*, *Gomphomacromia* (*G. paradoxus* Br., but not *G. volxemi* Selys), *Pseudocordulia*, *Aus-*

trophya, *Idionyx*, *Neophya*; and probably also *Idomacromia*, about which our knowledge is far too little to make a definite position possible.

The relation of the four main groups of the *Corduliinae* may now be illustrated as follows :—



Returning now to the question of *Hesperocordulia* and *Lathrocordulia*, it seems, at first sight, that these two genera are very closely allied. This may be actually the case, or it may be the result of convergence; the point can probably not be definitely settled until the life-histories are known. The important thing is to recognise that, in the natural development of coordinate groups, the *first* divergence or dichotomy must have yielded two closely allied forms; and that it has been the gradual widening of the gap, by development along the two new lines, that provides us with the main characters for our group-classification. Now in the imago of *Hesperocordulia*, we find the *beginning* of the tendency towards an elongated anal loop (the same is shewn in *Oxyastra*); we have a hindwing-triangle practically quite recessed, and we have also a robust development of head and thorax, and very long legs. Place the insect side by side with *Lathrocordulia*, and the remarkable difference in the length of the legs is at once seen. Comparing the two anal loops, the shortness of the loop in *Lathrocordulia* is intensified by its lack of a definite longitudinal bisector; in *Hesperocordulia* the bisector is fairly distinct, and the apical end of the loop is closed by a straight vein. *Lathrocordulia* is clearly very close to *Syncordulia*, and should be placed in the *Idocordulina*, *Hesperocordulia*, on the other hand, in spite of its thin abdomen, is certainly on the road to full *Eucordulina*-development.

The following table shews, at a glance, the more important generic characters of *Hesperocordulia*, and the five Australian genera comprised in the group *Idocordulina* :—

Genus.	Head.	Thorax.	Legs.	Recession of Hindwing-triangle.	Rows of cells after Forewing-triangle.	Sectors of arculus at bases.	Second antennal nodal in line with arculus or not.	Second cubital cross-vein in Hindwing.	Anal loop.
<i>Hesperocordulia</i> Type, <i>A. berthoulti</i> , n. sp.	large	large	very long	practically quite complete	1	apart	no	absent	10-celled, elongated, bisector present, end cut off square.
<i>Lathrocordulia</i> Type, <i>L. metallica</i> , n. sp.	large	large	short	not quite complete	1	apart	no	present before arculus	8-9 celled, irregular, no bisector, end not cut off square.
<i>Syncordulia</i> [Type, <i>S. gracilis</i> Burm.]	small	small	very short	incomplete	1	apart	no	present at arculus	11-celled, short rounded, no bisector.
<i>Austrocordulia</i> Type <i>A. refracta</i> Tillyard	medium	small	very short	incomplete	2	apart	no	absent	7-celled, short, no bisector.
<i>Pseudocordulia</i> Type, <i>P. circularis</i> Tillyard	medium	small	short	incomplete	1	united	yes	present after arculus*	4-celled, very short, rounded, no bisector.
<i>Austrophya</i> Type, <i>A. mystica</i> Tillyard	small	very small	very short	practically complete	1	just united	no	present at arculus	narrow and short, one row of 4 cells only.

*By an unfortunate error, this cross-vein was omitted in the figure of this species in my former paper, *loc. cit.*, fig 1, Pl. xxii.

EXPLANATION OF PLATE X.

- Fig. 1.—Basal portion of wings of *Hesperocordulia berthoudi* ♂, n.gen. et sp.
 Fig. 2.—Basal portion of wings of *Lathrocordulia metallica* ♂, n.gen. et sp.
 Fig. 3.—Appendages of *Hesperocordulia berthoudi* n.sp. ♂, dorsal view.
 Fig. 4.—Appendages of *Lathrocordulia metallica* n.sp. ♂, dorsal view.
 Fig. 5.—Appendages of *Hemicordulia superba* n.sp. ♂, dorsal view.
 Fig. 6.—Appendages of *Hemicordulia superba* n.sp. ♂, lateral view.
 Fig. 7.—Appendages of *Hemicordulia superba* n.sp. ♀, lateral view.
 Fig. 8.—Ventral view of seg. 9 of *Hemicordulia superba* n.sp. ♀.
 Fig. 9.—Appendages of *Hesperocordulia berthoudi* n.sp. ♂, lateral view.
 Fig. 10.—Appendages of *Lathrocordulia metallica* n.sp. ♂, lateral view.
 Fig. 11.—Pterostigma of *Macromia viridescens* n.sp. ♀.

[Figs. 1-2, ×; figs. 4-11, × 10.]

Postscript, added August 14th, 1911.—In a letter just received from M. René Martin, the following words are used by him regarding *Hemicordulia novæ-hollandiæ* (I translate from his letter, written in French):—“*Hemicordulia continentalis* differs from *H. novæ-hollandiæ* by the *facies*. It is a smaller, shorter and thicker dragonfly. The thorax is more entirely deep metallic blue above, the abdomen appears quite black above, the yellow colour of the sides is placed lower down and is scarcely visible; whereas in *H. novæ-hollandiæ* the yellow is very broad and apparent. *H. continentalis* is perhaps a race or form of *H. novæ-hollandiæ*, but the *facies* is very different. In the female of *H. novæ-hollandiæ* in my collection, and that which I have seen, the abdomen is long, not narrowed at segment 2; 2-3 very yellow above; in the female of *H. continentalis*, the abdomen is shorter, narrowed at segment 2, and then cylindrical, with a little yellow on the sides of 2-3; the wings shorter, the thorax more touched with metallic green; segment 10 is nearly all black, scarcely edged with yellow at the extreme tip.”

With these words before me, I am still of opinion that the two are not specifically distinct,

R. J. TILLYARD,